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Best Demonstrated Available Technology (BDAT) Background Document for Phthalate Wastes (Proposed) (Volume 1)

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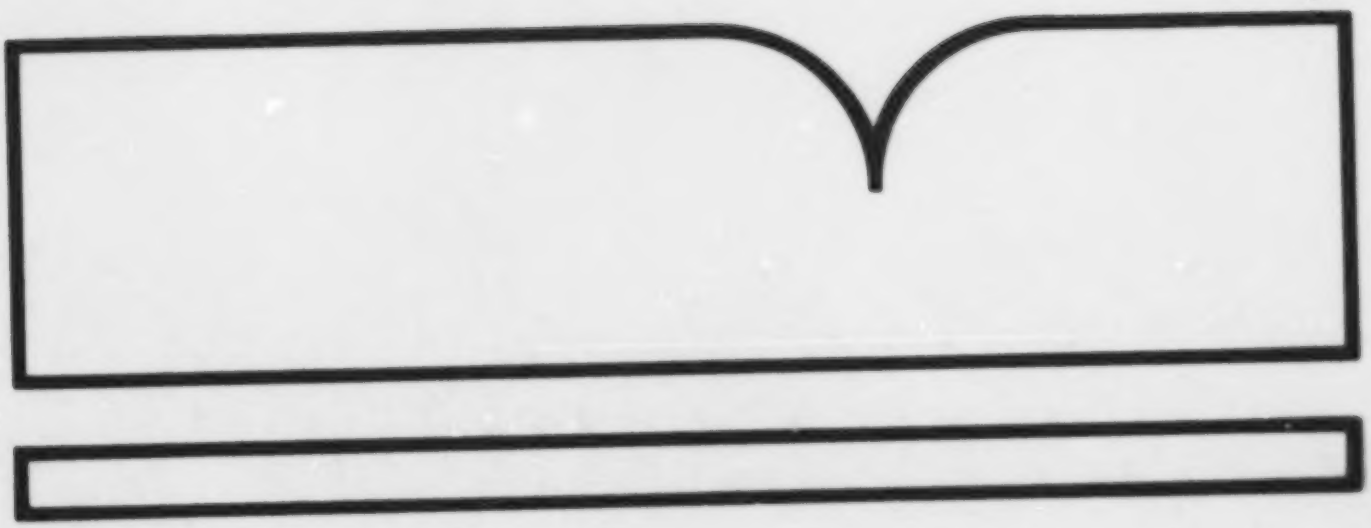

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This background document provides the Agency's technical support for selecting and developing treatment standards for the constituents to be regulated in the phthalate wastes. Sections 2 - 7 present waste-specific information for the K022, K093, and K094 wastes. Section 2 presents the number and location of facilities affectee by the land disposal restrictions, the waste generating process, and the waste characterization data. Section 3 presents the technologies used to treat the wastes (or similar wastes). Section 4 presents the available performance data, including data on which the proposed treatment standards are based. Section 5 explains EPA's determination of BDAT, while Section 6 discusses the slection of constituents to be regulated. Proposed treatment standards are determined in Section 7. Section 8 presents a discussion of the development of proposed treatment standards for those phthalate wastes designated as U wastes (U028, U069, U088, U102, U107, and U190).

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PB89-142244

PROPOSED

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

BACKGROUND DOCUMENT FOR

PHTHALATE WASTES

Volume 1

Robert April, Chief
Treatment Technology Section

Lisa Jones
Project Manager

U.S. Environmental Protection Agency
Office of Solid Waste
401 M Street, S.W.
Washington, D.C. 20460

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1. INTRODUCTION

Pursuant to section 3004(m) of RCRA as enacted by the Hazardous and Solid Waste Amendments (HSWA) on November 8, 1984, the Environmental Protection Agency (EPA) is proposing treatment standards based on the best demonstrated available technology (BDAT) for the waste treatability group identified as phthalate wastes. This treatability group includes wastes identified in 40 CFR 261.32 as K023, K093, and K094 and in 40 CFR 261.33 as U028, U069, U088, U102, U107, and U190. Compliance with these proposed BDAT treatment standards is a prerequisite for the placement of these wastes in units designated as land disposal units according to 40 CFR Part 268. The proposed effective date of these treatment standards is June 8, 1989.

This background document provides the Agency's technical support for selecting and developing treatment standards for the constituents to be regulated in the phthalate wastes. Sections 2 through 7 present waste-specific information for the K023, K093, and K094 wastes. Section 2 presents the number and location of facilities affected by the land disposal restrictions, the waste generating process, and the waste characterization data. Section 3 presents the technologies used to treat the wastes (or similar wastes). Section 4 presents the available performance data, including data on which the proposed treatment standards are based. Section 5 explains EPA's determination of BDAT, while Section 6 discusses the selection of constituents to be regulated. Proposed treatment standards are determined in Section 7. Section 8

presents a discussion of the development of proposed treatment standards for those phthalate wastes designated as U wastes (U028, U069, U088, U102, U107, and U190).

The BDAT program and promulgated methodology are more thoroughly described in two additional documents: Methodology for Developing BDAT Treatment Standards (USEPA 1988f) and Generic Quality Assurance Project Plan for Land Disposal Restrictions Program ("BDAT") (USEPA 1987). The petition process to be followed in requesting a variance from the BDAT treatment standards is discussed in the methodology document.

It is EPA's understanding that only six facilities produce phthalic anhydride. The Agency is proposing to regulate one organic constituent in both nonwastewater and wastewater forms of K023, K093, and K094 wastes. (For the purpose of determining the applicability of the proposed treatment standards, wastewaters are defined as wastes containing less than 1 percent (weight basis) total suspended solids* and less than 1 percent (weight basis) total organic carbon (TOC). Wastes not meeting this definition must comply with the proposed treatment standards for nonwastewaters.)

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*The term "total suspended solids" (TSS) clarifies EPA's previously used terminology of "total solids" and "filterable solids." Specifically, the quantity of total suspended solids is measured by Method 209c (Total Suspended Solids Dried at 103 to 105°C) in Standard Methods for the Examination of Water and Wastewater, 16th Edition (APHA, AWWA, and WPCF 1985).

Proposed BDAT treatment standards for wastewaters and nonwastewaters for K023, K093, and K094 (see Table 1-1) have been directly transferred from the promulgated treatment standards for K024 wastes (covered under first third BDAT list of hazardous wastes). Table 1-2 presents proposed BDAT treatment standards for wastewaters and nonwastewaters for U phthalates (U028, U069, U088, U102, U107, and U190) which have also been transferred from the promulgated treatment standards for K024 wastes. These proposed treatment standards are based on total concentration analyses of the ash residues, and the scrubber water generated during rotary kiln incineration of K024 waste. If the concentrations of the regulated constituents, as generated or as present in the treatment residuals, are lower than or equal to the proposed BDAT treatment standards, then treatment is not necessary as a prerequisite to land disposal.

Table 1-1 BDAT Treatment Standards for K023, K093, and K094 Wastes

Constituent	Maximum for any single grab sample		
	Nonwastewater		Wastewater
	Total concentration (mg/kg)	TCLP leachate concentration (mg/l)	Total concentration (mg/l)
Semivolatile organics			
Phthalic acid[a]	28	NA	0.54

NA = Not applicable.

[a]This constituent is regulated as a surrogate for phthalic anhydride, which cannot be easily analyzed because it is rapidly hydrolyzed and converted to phthalic acid during chemical analysis.

Table 1-2 BDAT Treatment Standards for U Phthalates U028, U069, U088, U102, U107, and U190, Respectively

Constituent	Maximum for any single grab sample		
	Nonwastewater		Wastewater
	Total concentration (mg/kg)	TCLP leachate concentration (mg/l)	Total concentration (mg/l)
Bis-(2-ethylhexyl) phthalate	28	NA	0.54
Di-n-butyl phthalate	28	NA	0.54
Diethyl phthalate	28	NA	0.54
Dimethyl phthalate	28	NA	0.54
Di-n-octyl phthalate	28	NA	0.54
Phthalic anhydride (reported as phthaliuc acid)	28	NA	0.54

2. INDUSTRIES AFFECTED AND WASTE CHARACTERIZATION

The purpose of this section is to describe the phthalic anhydride industry affected by the land disposal restrictions for K023, K093, and K094 and to present available characterization data for these wastes.

Under 40 CFR 261.32, wastes identified as K023, K093, and K094 are specifically generated in the production of phthalic anhydride and are listed as follows:

K023: Distillation light ends from the production of phthalic anhydride from napthalene.

K093: Distillation light ends from the production of phthalic anhydride from ortho-xylene.

K094: Distillation bottoms from the production of phthalic anhydride from ortho-xylene.

The Agency has determined that these listed wastes (K023, K093, and K094) represent a single waste treatability group based on their similar chemical characteristics. The Agency has examined the source of the wastes, the specific similarities in waste composition, applicable and demonstrated treatment technologies, and attainable treatment performance in order to support the approach proposed for these listed wastes.

2.1 Industry Affected and Process Description

2.1.1 K023 Waste

The listed waste, K023, is generated in a distillation column as light ends during the production of phthalic anhydride from napthalene in the organic chemical industry. The Agency estimates that currently only one facility uses this process and may generate K023 waste. This

facility, which is located in the State of Illinois (EPA Region V), generates approximately 300 tons of K023 waste per year.

Phthalic anhydride can be manufactured by a process that uses a vaporized napthalene and air mixture fed into a fixed-bed reactor containing a vanadium pentoxide catalyst. The naphthalene is oxidized to phthalic anhydride, carbon dioxide, and water vapor at a temperature of about 350°C. These gases pass through a vapor cooler that reduces the gas temperature to just below the gases' dew point (126°C). The condensed liquid is then routed into crude phthalic anhydride storage.

The crude phthalic anhydride is subsequently heated at atmospheric pressure to dehydrate traces of phthalic acid and to convert other compounds to compounds having higher boiling points, which can be separated from the product during distillation. Other chemicals are added to shorten the time required for purification. These chemicals include sodium carbonate, sodium hydroxide, or a material to tie up naphthoquinone in a polymer state so that it can be easily removed from the product. The light ends from the distillation column constitute the waste stream K023. Figure 2-1 is a process schematic of the manufacture of phthalic anhydride and the generation of the listed waste K023.

2.1.2 K093 and K094 Wastes

The listed waste K093 is generated in a distillation column as light ends during the production of phthalic anhydride using ortho-xylene as feed material. The distillation bottoms from the production of phthalic

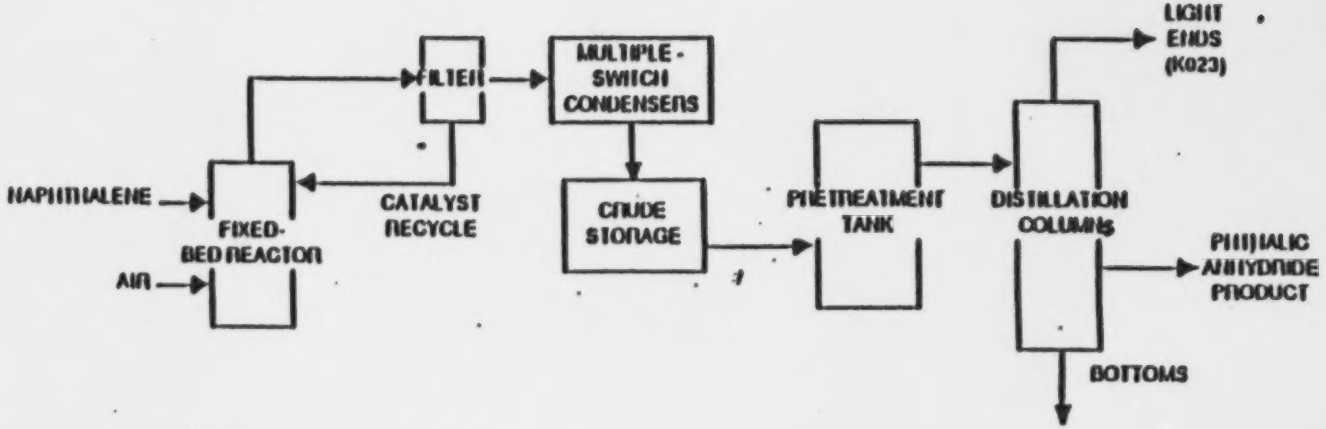

Figure 2-1 Schematic diagram of the generation of K 023

anhydride from the ortho-xylene are the listed waste K094. The Agency estimates that six facilities may generate K093 and/or K094. These facilities are listed on Table 2-1. Approximately 1,000 ton/yr of K093 and K094 wastes are generated (USEPA 1986).

Phthalic anhydride can be manufactured by the vapor phase oxidation of ortho-xylene. Ortho-xylene is mixed with air and fed to a fixed-bed tubular reactor containing vanadium pentoxide catalyst. Phthalic anhydride is formed by the following reaction:

$$C_6H_4(CH_3)_2 + 3O_2 \rightarrow C_6H_4(CO)_2O + 3H_2O$$

The crude reactor effluent is condensed and sent to a distillation column, where the light ends are removed as K093 waste. The stripped phthalic anhydride is then distilled in a second column, where the heavy ends or bottoms are removed as K094. Figure 2-2 is a process schematic of the manufacture of phthalic anhydride and the generation of the listed wastes K093 and K094.

2.2 Waste Characterization

2.2.1 K023 Waste

All waste characterization data available to the Agency for K023 waste are presented in Table 2-2. The table shows the major constituents in the waste and their approximate concentrations. The percent concentration of each major constituent in the waste was determined from best estimates based on chemical analyses and discussion with the one known generator. At least 87 percent of the waste is composed of the BDAT list constituent phthalic anhydride. Usually, less than 0.5 percent

Table 2-1 Facilities That May Generate K023, K093 and K094 Wastes

Name of facility	Capacity (10^6 lb/yr) of phthalic anhydride product	Raw material	EPA region
BASF Corporation, Kearny, NJ	175	ortho-xylene	II
Exxon Corporation, Baton Rouge, LA	220	ortho-xylene	VI
Koppers Company, Cicero, IL	125[a]	Coal tars-naphthalene	V
	100	ortho-xylene	
Stepan Company, Millsdale, IL	170	ortho-xylene	V
Sterling Chemical Co., Texas City, TX	165	ortho-xylene	VI
Tenn-USS Chemical Co., Pasadena, TX	210	ortho-xylene	VI

[a]This unit can also be operated on ortho-xylene feed.

Reference: SRI 1988.

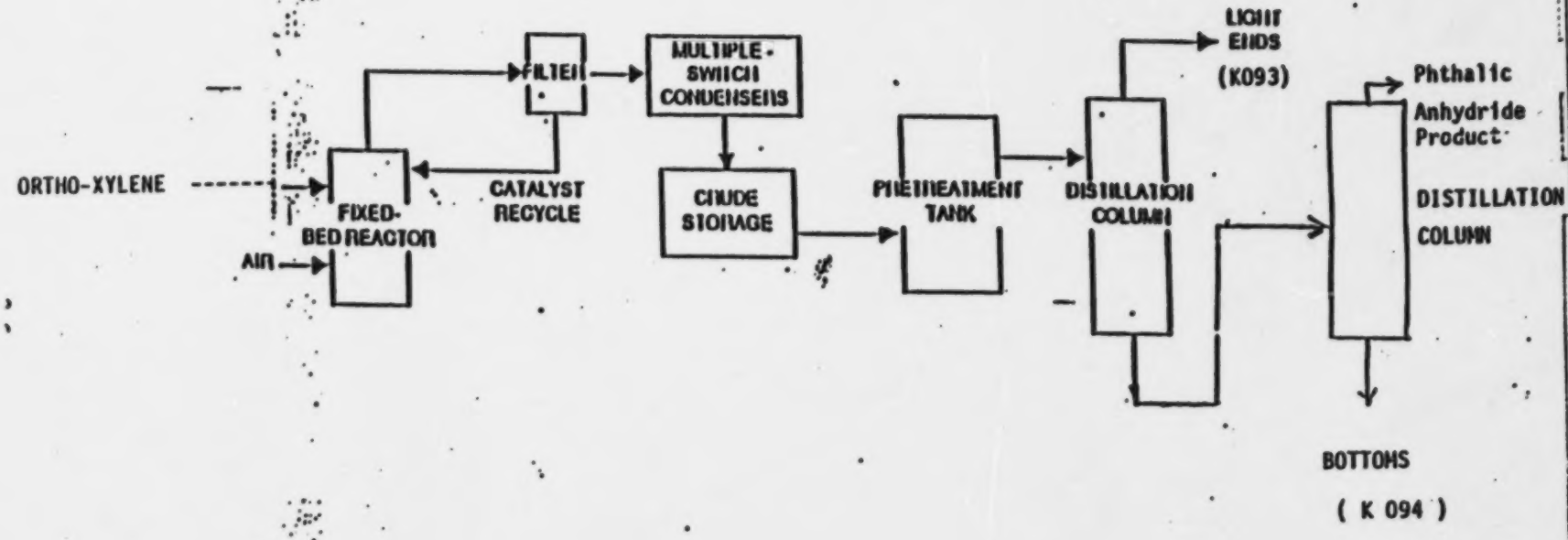

Figure 2-2 Schematic diagram of the generation of K 093 and K 094

Table 2-2 K023 - Waste Composition Data

	Conc. range (%)	Plant 1 (%)	Plant 2 (%)
BOAT list constituents			
Phthalic anhydride	87-99	87-90	92-99
Maleic anhydride	<0.5		<0.5
Other constituents			
Benzoic acid	1-13	10-13	1-6

Reference: USEPA 1985.

of this waste is maleic anhydride. No other BDAT list constituent (except phthalic anhydride and maleic anhydride) was detected at treatable concentrations in the untreated waste sample.

2.2.2 K093 and K094

All waste characterization data available to the Agency for K093 and K094 wastes are presented in Tables 2-3 and 2-4. The tables show the major constituents in the wastes and their approximate concentrations. The percent concentration of each major constituent in the waste was determined from best estimates based on chemical analyses and data from other sources. In K093 and K094, the BDAT list constituent phthalic anhydride is present in the waste at treatable concentrations. In K093, the BDAT list constituent maleic anhydride is also likely to be present at treatable concentrations. No other BDAT list constituents are expected to be present in the untreated K093 and K094 wastes at treatable concentrations.

2.3 Determination of Waste Treatability Group

In cases where EPA believes that constituents present in wastes represented in different codes can be treated to similar concentrations by using the same technology, the Agency may combine the waste codes into one treatability group.

Based on the methods of generation and waste characterization data available to the Agency for K023, K093, and K094 wastes, the Agency has determined that these three wastes represent a single waste treatability group. These three wastes are generated by the phthalic anhydride manufacturing industry. They are also generated from similar processes

Table 2-3 K093 - Waste Composition Data (ppm)

	Conc. range (%)	Plant 1 (%)	Plant 2 (%)
BOAT list constituents			
Phthalic anhydride	10-36	10	36
Maleic anhydride	23-90	90	23
Other constituents			
Benzoic acid	0-38		38
Toluic acid	0-1.5		1.5
Toluic aldehyde	0-1.5		1.5

Reference: USEPA 1985.

Table 2-4 K094 - Waste Composition Data

	Conc. range (%)	Plant 1 (%)	Plant 2 (%)
BOAT list constituents			
Phthalic anhydride	44.5-50	44.5	50
Other constituents			
Anthraquinone	0-6		6
Quinones	0-1.0	1.0	
Tars	39-54.5	54.5	39
Toluic acid	0-1.5		1.5
Toluic aldehyde	0-1.5		1.5
Trimellitic anhydride	0-1.5		1.5
Na_2CO_3	0-0.2		0.2

Reference: USEPA 1985.

i.e., during the purification step of phthalic anhydride manufacture. Although the concentrations of specific constituents will vary from waste code to waste code, all of the wastes contain similar constituents (i.e., major constituents present are phthalic anhydride and maleic anhydride) and are expected to be treatable to similar levels using the same technology. The Agency has examined the source of these wastes, the specific similarities in waste composition, applicable and demonstrated treatment technologies, and attainable treatment performance in order to support a single regulatory approach proposed for these listed wastes.

3. APPLICABLE AND DEMONSTRATED TECHNOLOGIES

Section 2 established one treatability group for the management of K023, K093, and K094 wastes. This section identifies the treatment technologies that are applicable to this treatability group and determines which, if any, of the applicable technologies can be considered demonstrated for the purposes of establishing BDAT.

To be applicable, a technology must be theoretically usable to treat the waste in question or to treat a waste that is similar in terms of the parameters that affect treatment selection.* To be demonstrated, the technology must be employed in full-scale operation for the treatment of the waste in question or a similar waste. Technologies available only at pilot- and bench-scale operations are not considered demonstrated technologies.

3.1 Applicable Treatment Technologies

Initial data gathering on the treatment of K023, K093, and K094 wastes included review of the technical literature and EPA's National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities (1986).

As shown in Section 2.2, and based on the processes generating K023, K093, and K094 wastes, these wastes are expected to contain some of the BDAT list organic constituents and are not expected to contain treatable levels of BDAT list inorganic constituents. Since K023, K093,

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*For detailed discussions of the technologies that are applicable for these wastes, or for wastes judged to be similar, refer to EPA's Treatment Technology Background Document (USEPA 1988a).

and K094 contain BDAT list organics, the Agency considers that the technologies applicable to the untreated listed wastes should include those that destroy or reduce the total amount of various organic compounds in the waste. Additionally, residuals (wastewaters and nonwastewaters) generated from the treatment of BDAT list organics should also be considered for further treatment, if necessary.

The Agency has identified incineration and fuel substitution as applicable destruction technologies because these technologies have been shown to treat organic wastes with high Btu content, low metals concentrations, and low water content. Incineration and fuel substitution are destruction technologies in which energy, in the form of heat, is transferred to the waste to destabilize chemical bonds and eventually destroy hazardous constituents by converting them to carbon dioxide, water, and other oxidized waste constituents. In general, two residuals are generated by incineration or fuel substitution processes: ash and scrubber water. The scrubber water from incineration/fuel substitution is designated as a wastewater form derived from the treatment of these listed wastes. The scrubber water is not expected to contain BDAT list organics at treatable levels since most of the organics are destroyed in the incinerator, furnace, or boiler.

The Agency believes that solvent extraction may be another applicable technology for K023, K093, and K094 nonwastewaters. The Agency also believes that biological treatment, steam stripping, and carbon adsorption are potentially applicable to wastewater forms of K023, K093, and K094 wastes.

Based on the waste generating processes the Agency does not expect the presence of BDAT list metals in K023, K093, and K094 wastes (both nonwastewaters and wastewaters); nor is there any reason to believe that they should be present at treatable levels. Therefore, there is no need to investigate technologies applicable for treating BDAT list metals.

3.2 Demonstrated Treatment Technologies

The Agency cannot identify any facilities that currently use incinerators to treat K023 waste. However, incineration is demonstrated on wastes that are similar to K023 (wastes that have a high Btu content and a high percentage of organics). Based on the waste characteristics of K023, the Agency also believes that fuel substitution is demonstrated on wastes similar to K023 wastes.

From the information available to the Agency, at least one of the generators of K093 and K094 uses fuel substitution. Hence, fuel substitution is demonstrated on K093 and K094 wastes. Since K023, K093, and K094 represent a single waste treatability group, fuel substitution and incineration are demonstrated treatment technologies on the K023, K093, and K094 waste group.

4. PERFORMANCE DATA BASE

This section presents the data available to EPA on the performance of demonstrated technologies in treating the listed wastes. These data are used elsewhere in the document for determining which technologies represent BDAT (Section 5), for selecting constituents to be regulated (Section 6), and for developing treatment standards (Section 7). Eligible data, in addition to full-scale demonstration data, may include data developed at research facilities or obtained through other applications at less than full-scale operation, as long as the technology is demonstrated in full-scale operation for a similar waste or wastes as defined in Section 3.

Where data are not available on the treatment of the specific wastes of concern, the Agency may elect to transfer data on the treatment of a similar waste or wastes, using a demonstrated technology. To transfer data from another waste category, EPA must find that the waste treatability group covered by this background document is no more difficult to treat (based on the waste characteristics that affect performance of the demonstrated treatment technology) than the treated wastes from which performance data are being transferred.

There are no performance data available to the Agency to characterize treatment for K023, K093, or K094. However, the Agency has a data base for incineration of a similar waste, K024, which, as defined by 40 CFR Part 261.32, is the distillation bottoms from the production of phthalic anhydride from napthalene. This similarity is based on the production processes, the waste compositions, and the waste characteristics

affecting performance of the demonstrated treatment technology. The Agency is transferring performance data from the treatment of K024 to the K023, K093, and K094 wastes since the Agency believes that these wastes are no more difficult to treat than the tested K024 waste.

The performance data base for K024 waste includes the untreated and treated waste concentrations for a given constituent, the values of operating parameters that were measured at the time the waste was being treated, the values of relevant design parameters for the treatment technology, and data on waste characteristics that affect performance of the treatment technology.

Tables 3-1 through 3-6 of the Best Demonstrated Available Technology (BDAT) Background Document for K024 (USEPA 1988c) present the data of total waste concentration analyses for K024 waste samples, as well as the design and operating data for the treatment system. Based on a review of the operating data obtained during collection of the samples, the data sets appear to reflect treatment by a well-operated system. Furthermore, in all cases the BDAT list organics detected in the untreated waste are reduced to nearly nondetectable levels in the treated residuals. No BDAT list metal constituents were detected in the untreated or treated wastes, nor are they expected to be present.

5. IDENTIFICATION OF BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

This section presents the Agency's rationale for the determination of best demonstrated available technology (BDAT) for K023, K093, and K094 nonwastewaters and wastewaters.

To determine BDAT, the Agency examines all available performance data on technologies that are identified as demonstrated to determine (using statistical techniques) whether one or more of the technologies performs significantly better than the others. In addition, all performance data used for determination of best technology must first be adjusted for accuracy, as discussed in EPA's publication, Methodology for Developing BDAT Treatment Standards. (An accuracy adjustment assesses the ability of an analytical technique to recover a particular constituent from the waste in a particular test. It is usually done by spiking a sample with a known amount of the target constituents and then comparing the amount recovered with results from unspiked samples.) BDAT must be specifically defined for all streams associated with the management of the listed wastes; this pertains to the original waste as well as to any residual waste streams created by the treatment process.

The technology that performs best on a particular waste or waste treatability group is then evaluated to determine whether it is "available." To be available the technology must (1) be commercially available to any generator and (2) provide "substantial" treatment of the waste, as determined through evaluation of accuracy-adjusted data. In determining whether treatment is substantial, EPA may consider data on

the performance of a waste similar to the waste in question provided that the similar waste is at least as difficult to treat. If the best technology is found to be not available, then the next best technology is evaluated, and so on.

Consistent with EPA's methodology for determining BDAT, the Agency evaluated the incineration performance data for the similar waste, K024, to determine whether this technology would provide statistically significant treatment for BDAT list organic constituents in K023, K093, and K094 wastes. Based on the evaluation of the design and operating parameters of the similar treatment system, the analytical testing, and the quality of the data, EPA determined that statistically significant treatment occurs. This determination is based on the findings that in all data sets, BDAT list organic constituents are reduced to nondetectable levels, or nearly to nondetectable levels, in the treatment residuals. In addition to achieving this substantial reduction, incineration is a widely available commercial technology. EPA concludes that incineration is, therefore, the best demonstrated available treatment for K023, K093, and K094 wastes.

As noted in Sections 3 and 4, BDAT list metals are not expected to be present in K023, K093, and K094 wastes. Hence, residuals from incineration will not require any treatment for BDAT list metals.

Since incineration for K023, K093, and K094 will generate two treatment residuals--ash (a nonwastewater form of K023, K093, and K094) and combustion gas scrubber water (a wastewater form of K023, K093, and K094)--BDAT must be identified for both types of waste streams.

5.1 BDAT for Nonwastewater

As discussed previously, EPA has identified incineration as the best demonstrated available technology for K023, K093, and K094 wastes as generated. The Agency believes that fuel substitution is the only other equivalent demonstrated technology for the treatment of K023, K093, and K094 nonwastewaters. As noted, incineration/fuel substitution produces one nonwastewater residual, ash. Since, in all cases, organic constituent levels in this residual are at or near nondetectable levels for the tested K024 waste, EPA concludes that no further treatment could improve upon the levels of performance achieved by incineration or fuel substitution alone and that no further treatment of the ash for the organic constituents is necessary. The performance data base for the tested K024 waste is available in Chapter 3 of the BDAT Background Document for K024. Incineration/fuel substitution is, therefore, also the basis for BDAT for nonwastewater residuals from incineration or fuel substitution of K023, K093, and K094 nonwastewaters.

5.2 Wastewaters

Scrubber water is the other residual likely to be produced by incineration or fuel substitution of K023, K093, and K094 nonwastewaters. From the treatment data for K024, the Agency concludes that levels of phthalic acid in this wastewater will be below detection limits. The Agency concludes, therefore, that no further treatment of this residual wastewater stream could improve upon the level of performance achieved by incineration/fuel substitution alone and that no

further treatment is required. Consequently, incineration/fuel substitution is the basis for BDAT for wastewater residuals from incineration or fuel substitution of K023, K093, and K094 nonwastewaters.

6. SELECTION OF REGULATED CONSTITUENTS

This section presents the rationale for the selection of regulated constituents for the treatment of K023, K093, and K094 wastes.

Constituents selected for regulation must satisfy the following criteria:

1. They must be on the BDAT list of regulated constituents. (Presence on the BDAT list implies the existence of approved techniques for analyzing the constituent in treated waste matrices.)

2. They must be present in, or suspected of being present in, the untreated waste. For example, in some cases, analytical difficulties (such as masking) may prevent a constituent from being identified in the untreated waste, but its identification in a treatment residual may lead the Agency to conclude that it is present in the untreated waste.

3. Where performance data are transferred, the selected constituents must be easier to treat than the waste constituent(s) for which performance data are transferred. Factors for assessing ease of treatment will vary according to the technology of concern. For instance, for incineration the factors include bond dissociation energy, thermal conductivity, and boiling point.

From the group of constituents that are eligible to be regulated, EPA may select a subset of constituents as representative of the broader group. For instance, out of a group of constituents that react similarly to treatment, the Agency might name only those that are the most difficult to treat as regulated constituents for the purpose of setting a standard.

6.1 Identification of Constituents in the Untreated Waste

The analytical data gathered or generated as part of the BDAT program were reviewed to select major constituents in the untreated waste. As a

general rule, any BDAT list constituent present in the waste at a treatable concentration would be eligible for selection.

Phthalic acid* and maleic anhydride** are the only BDAT list constituents detected in the untreated waste. These constituents and their concentrations identified in the untreated K023, K093, and K094 wastes are listed in Tables 2-2, 2-3, and 2-4.

6.2 Constituents Selected for Regulation

Phthalic anhydride is selected as the only regulated constituent for K023, K093, and K094 because this constituent is present in the untreated waste at treatable concentrations. Maleic anhydride may also be present in K023 and K093 wastes at treatable concentrations. Since maleic anhydride is more volatile and has a lower bond energy than phthalic anhydride, the Agency believes that maleic anhydride will be controlled more easily by incineration than will phthalic anhydride. Hence, in the course of achieving any regulatory limit set for phthalic acid (surrogate for phthalic anhydride), maleic anhydride will also be adequately controlled. There were no other BDAT list organic constituents detected or suspected to be present in the untreated K023, K093, and K094 wastes. As noted earlier, the Agency has no data that suggest the presence of

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*Phthalic anhydride is a BDAT list constituent that cannot be easily analyzed because the analytical method rapidly hydrolyzes the compound to phthalic acid. Therefore, phthalic acid, although not a BDAT list constituent, is being regulated as a surrogate for phthalic anhydride.

**Maleic anhydride is being added to the BDAT list of hazardous constituents.

BDAT list metals in K023, K093, and K094 wastes. Therefore, EPA has chosen not to regulate BDAT list metals for K023, K093, and K094 at this time.

7. DEVELOPMENT OF BDAT TREATMENT STANDARDS

The Agency bases treatment standards for regulated constituents on the performance of well-designed and well-operated BDAT treatment systems. These standards must account for analytical limitations in available performance data and must be adjusted for variabilities related to treatment, sampling, and analytical techniques and procedures.

BDAT standards are determined for each constituent by multiplying the arithmetic mean of accuracy-adjusted constituent concentrations detected in treated waste by a "variability factor" specific to each treatment technology defined as BDAT. Accuracy adjustment of performance data has been discussed in Section 5 in relation to defining "substantial treatment." Variability factors correct for normal variations in the performance of a particular technology over time. They are designed to reflect the 99th percentile level of performance that the technology achieves in commercial operation. (For more information on the principles of calculating variability factors, see EPA's publication Methodology for Developing BDAT Treatment Standards (USEPA 1988f). For details on the calculation of variability factors for K024 waste, see the Best Demonstrated Available Technology (BDAT) Background Document for K024 (USEPA 1988c).)

Where EPA has identified BDAT for a particular waste, but because of data limitations or for some other compelling reason cannot define specific treatment standards for that waste, the Agency can require the use of that treatment process as a technology standard. Similarly, where there are no known generators of a waste, or where EPA believes that the

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Table 7-1 Calculation of BDAT Proposed Treatment Standards for K024

Constituent	Concentration in treated waste	Analytical accuracy correction factor	Average accuracy-corrected concentrations	Variability[a] factor	Proposed BDAT treatment standard
Phthalic acid[b] in nonwastewater (ash)	<8.2 mg/kg	1.19	9.8 mg/kg	2.8	28 mg/kg
Phthalic acid[b] in wastewater (scrubber water)	<160 µg/l	1.2	192 µg/l	2.8	0.54 mg/l

[a]Variability factor of 2.8 is used when all samples are below the detection limit for the constituent.
[b]Used as a surrogate for phthalic anhydride, which is a constituent of K024.

Reference: USEPA 1988c.

Table 7-2 BDAT Proposed Treatment Standards for K023, K093, and K094

Constituent	Proposed BDAT treatment standard total composition
Phthalic acid[a] in nonwastewater	28 mg/kg
Phthalic acid[a] in wastewater	0.54 mg/l

[a]Used as a surrogate for phthalic anhydride.

8. U WASTE CODES

This section addresses the development of proposed treatment standards for those U wastes designated as phthalates. These wastes include U028 (bis-(2-ethyihexyl) pthalate), U069 (di-n-butyl phthalate), U088 (diethyl phthalate), U102 (dimethyl phthalate), U107 (di-n-octyl phthalate), and U190 (phthalic anhydride). The U phthalates have similarities in chemical structure and elemental content of the primary constituent of concern (i.e., phthalate) in each waste. Because of these similarities these wastes should be treatable to similar concentrations using the same technology; therefore, the Agency combined these codes into one treatability group.

According to 40 CFR 261.33, the above-mentioned materials are hazardous wastes when they are discarded or are intended to be discarded; when they are mixed with waste oil, used oil, or another material; and when they are applied to the land or are contained in products that are applied to the land.

These materials can be present in different forms. These forms include:

- Any commercial or off-specification commercial chemical product with any of the above generic names;
- Residues remaining in containers that held any of the above-mentioned products; or

- The residue of contaminated soil, water, or other debris that results when there is a cleanup of a commercial or off-specification commercial chemical product or manufacturing chemical intermediate having the generic name of any of the above-listed products that had been spilled onto the land or into the water.

8.1 Development of Treatment Standards

Some of the industries that may generate U code phthalate wastes are industries that manufacture phthalate plasticizers, unsaturated polyester resins, and alkyd resins, as well as other users of phthalate compounds. Table 8-1 presents the number of facilities that may generate U028, U069, U088, U102, U107, and U190 in each EPA region.

Since these listed compounds are all organics, incineration is applicable and demonstrated for U phthalate nonwastewaters, as it was for the K023, K024, K093, and K094 phthalate wastes.

BDAT standards for all of these U wastes are proposed based on transfer of data from the performance of rotary kiln incineration for K024 nonwastewaters (distillation bottoms from the production of phthalic anhydride from naphthalene). Treatment standards for K024 wastewaters and nonwastewaters were promulgated with the First Third wastes on August 8, 1988. These standards were based on the performance of incineration of K024 nonwastewaters in a rotary kiln and the concentrations of hazardous constituents found in the ash (nonwastewater) and scrubber water (wastewater) residuals. In today's rule, the Agency is proposing to transfer these treatment standards to U028, U069, U088, U102, U107, and U190.

Table 8-1 Number of Facilities That May Generate U028, U069, U088, U102, U107, and U190 in Each EPA Region

EPA region	Number of facilities
I	5
II	4
III	6
IV	5
V	12
VI	8
VII	0
VIII	1
IX	1
X	1

Reference: USEPA 1986.

Except for U190 (i.e., phthalic anhydride, which forms phthalic acid by a simple reaction with water), all of these U wastes are esters of phthalic acid. These esters are commonly referred to as phthalates. The difference between these compounds is merely the number of methylene ($-CH_2-$) hydrocarbon groups on each ester group (e.g., diethyl phthalate has one more methylene on each ester group than dimethyl phthalate). EPA believes that these structural similarities, coupled with the fact that all of these compounds are not anticipated to be more difficult to burn than phthalic acid, are sufficient evidence to support the transfer of the performance data for phthalic acid (from K024) to these individual U phthalates. Therefore, the Agency intends to propose treatment standards for each individual compound based on these data. Additionally, EPA is also proposing the same BDAT treatment standards for wastes identified as U190, phthalic anhydride, because it is the same as the regulated constituent of K024.

These U wastes are grouped as "phthalates" in order to solicit specific comments from manufacturers and users of phthalates regarding standards for these wastes. Several petitions have been submitted to EPA to remove certain phthalates from RCRA, TSCA, and SARA lists of hazardous materials. In addition, analyses for these constituents are often complicated by the high probability of cross-contamination by these constituents in the laboratory. They are common contaminants in plastics (such as plastic gloves used during the analyses) because of their presence as plasticizers.

While the proposed treatment standards for nonwastewaters (ash) and wastewaters (scrubber water) for these U phthalate wastes are based on the performance of incineration of K024 in a rotary kiln, other treatment technologies that can achieve these standards, such as fluidized bed incineration, fuel substitution, biodegradation, and solvent extraction, are not precluded from use by this rule. Since all of these compounds consist only of carbon, hydrogen, and oxygen, it is highly likely that these wastes could go to fuel substitution or to cement kilns as alternatives to incineration. The Agency is currently unaware of any alternative treatment or recycling technologies that have been examined specifically for these wastes and solicits data and comments on these.

Tables 8-2 and 8-3 present the proposed standards the U phthalate wastes, which are derived from a direct transfer of the numerical value for phthalic acid to the respective phthalate compound for the nonwastewater and wastewater residuals. The Agency believes that the relatively high numerical values for each individual phthalate will account for the potential contamination problems (as previously discussed) that are anticipated from handling wastes that contain very high concentrations of these phthalates (i.e., the U wastes). All standards are based on analysis of total constituent concentration.

Table 8-2. Proposed BDAT Treatment Standards for U Phthalates U028, U069, U088, U102, U107, and U190, Respectively (Nonwastewaters)

Constituent	Maximum for any single grab sample: Total composition (mg/kg)	Maximum for any single grab sample: TCLP (mg/l)
Bis-(2-ethylhexyl) phthalate	28	Not applicable
Di-n-butyl phthalate	28	"
Diethyl phthalate	28	"
Dimethyl phthalate	28	"
Di-n-octyl phthalate	28	"
Phthalic anhydride . . . (reported as phthalic acid)	28	"

Table 8-3. Proposed BDAT Treatment Standards for U Phthalates U028, U069, U088, U102, U107, and U190, Respectively (Wastewaters)

Constituent	Maximum for any single grab sample: Total composition (mg/kg)	Maximum for any single grab sample: TCLP (mg/l)
Bis-(2-ethylhexyl) phthalate	0.54	Not applicable
Di-n-butyl phthalate	0.54	"
Diethyl phthalate	0.54	"
Dimethyl phthalate	0.54	"
Di-n-octyl phthalate	0.54	"
Phthalic anhydride . . . (reported as phthalic acid)	0.54	"

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